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Bloch Oscillations of Electrons in a Quantum-Dot Superlattice[1]
DANHONG HUANG, Air Force Research Laboratory, S.K. LYO, Sandia National Laboratories — Numerical results for both the transient and steady-state currents in a strong DC electric field are presented for electrons in a quantum-dot superlattice. A microscopic scattering model is applied to study the dynamics of electrons scattered by impurities and phonons based on the Boltzmann equation. Good agreement is found between the numerical results and a recent analytic solution under a relaxation-time approximation for electron-phonon scattering [S. K. Lyo, Phys. Rev. B 77, 195306 (2008)]. Different roles played by elastic and inelastic scattering on the damped Bloch oscillations and the nonlinear steady-state are demonstrated from our numerical results. We will also briefly discuss suppression of the dynamical localization by strong Bloch oscillations under an additional nonlinear AC field and opposite roles played by elastic and inelastic scattering on the damped dynamical localization.

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